Decomposing the mid-infrared emission of AGN to study the disappearance of the torus at the low-luminosity end

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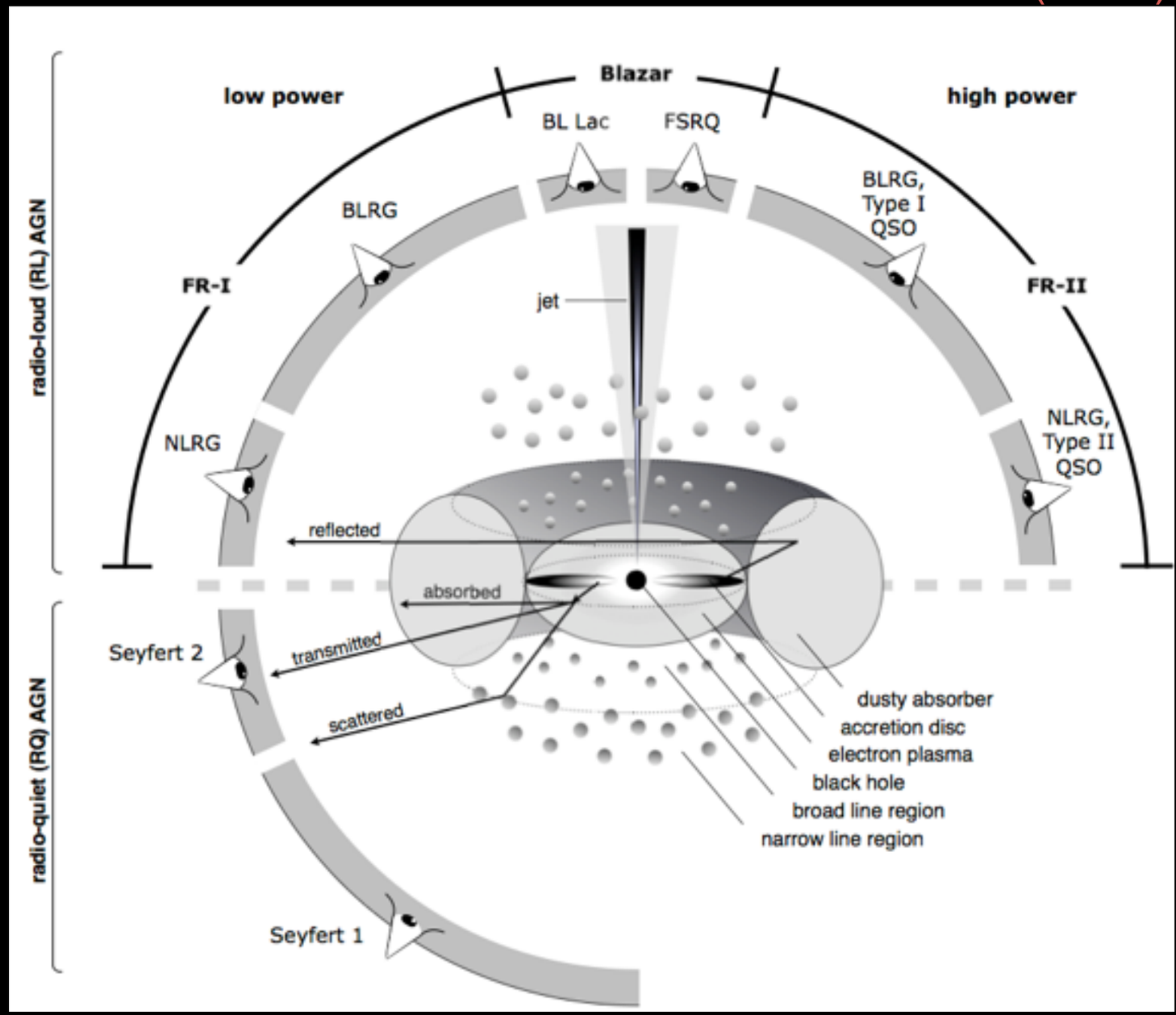
Introduction

Low-luminosity AGN, Why to care?

Beckmann & Shrader (2012)



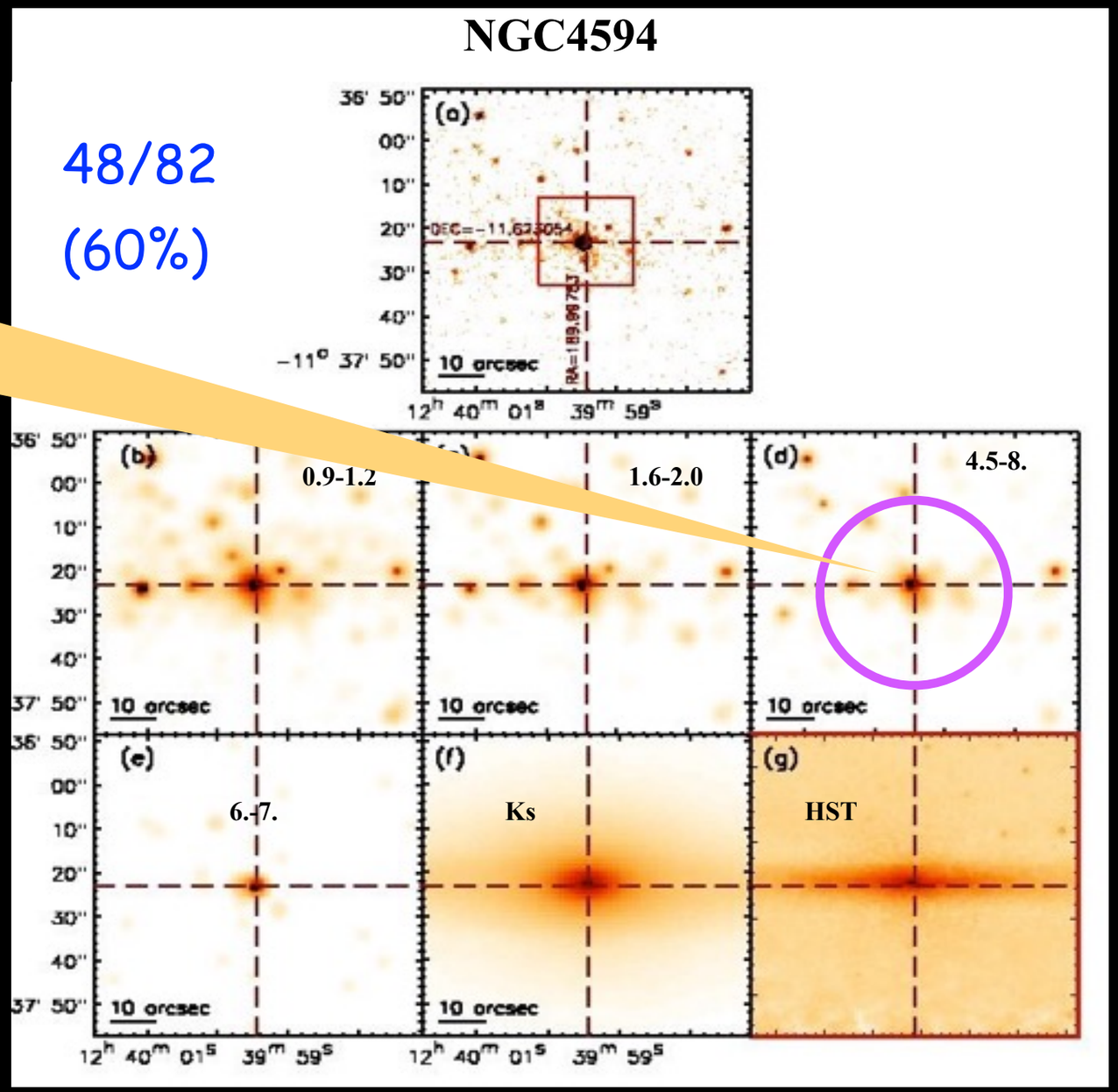
Introduction

González-Martin et al.(2009A)

More than 90% of them are AGN powered

48/82

(60%)



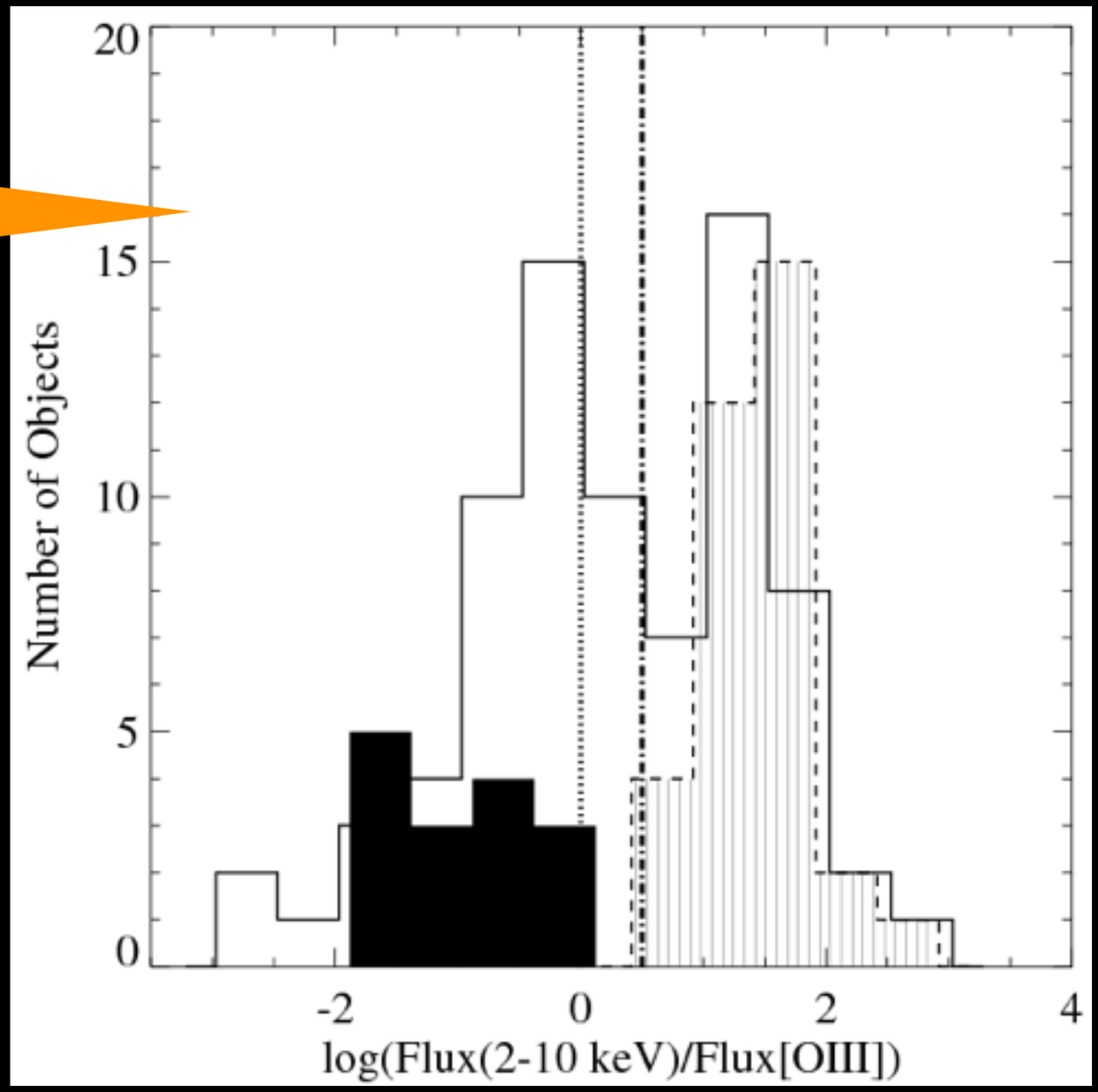
Introduction

González-Martin et al.(2009B)

Torus?

50% of LINERs are Compton-thick candidates

(compared to 20–30% in Seyferts Panessa et al.2006)

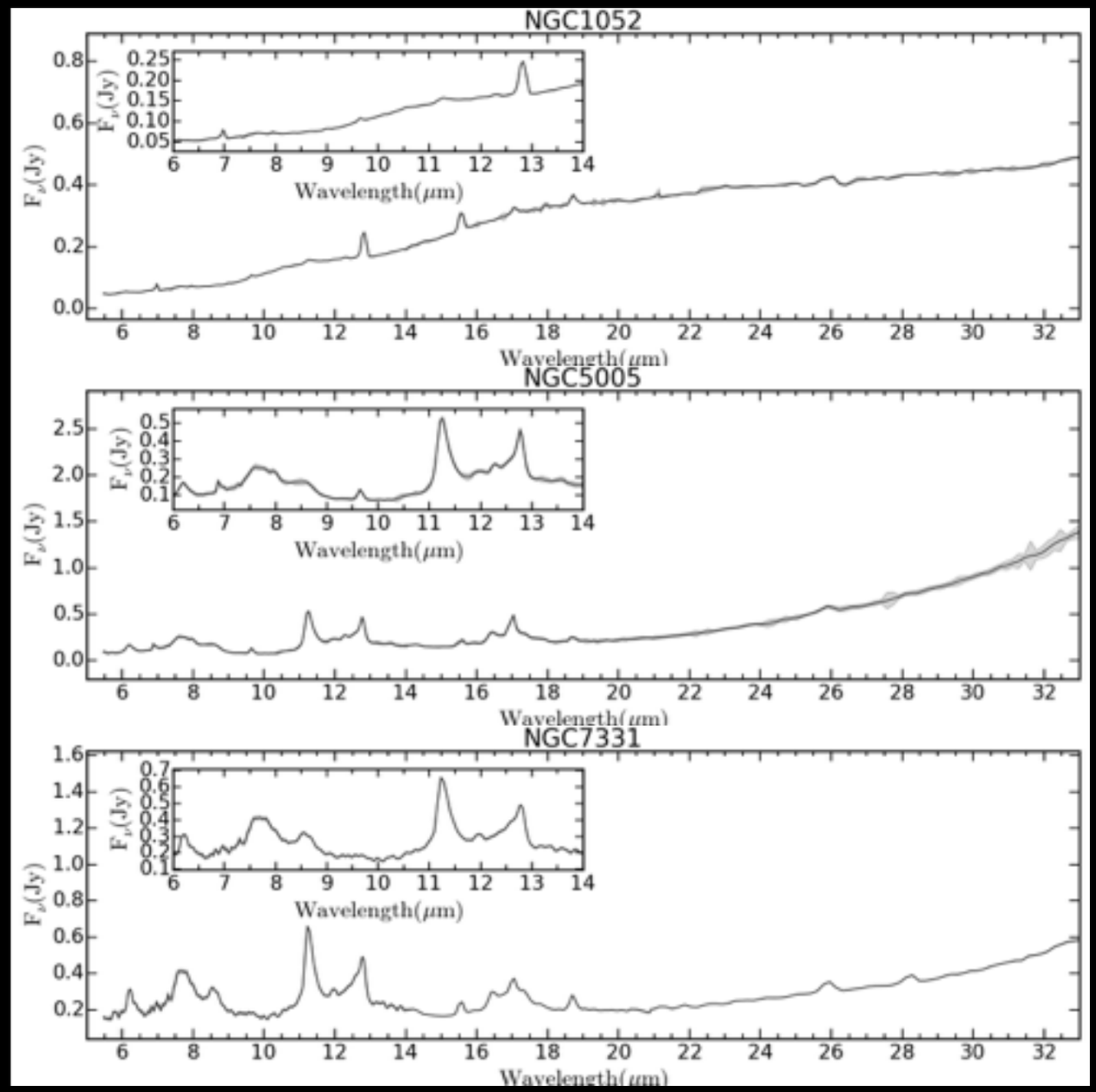


Sample

González-Martin et al.(2015)

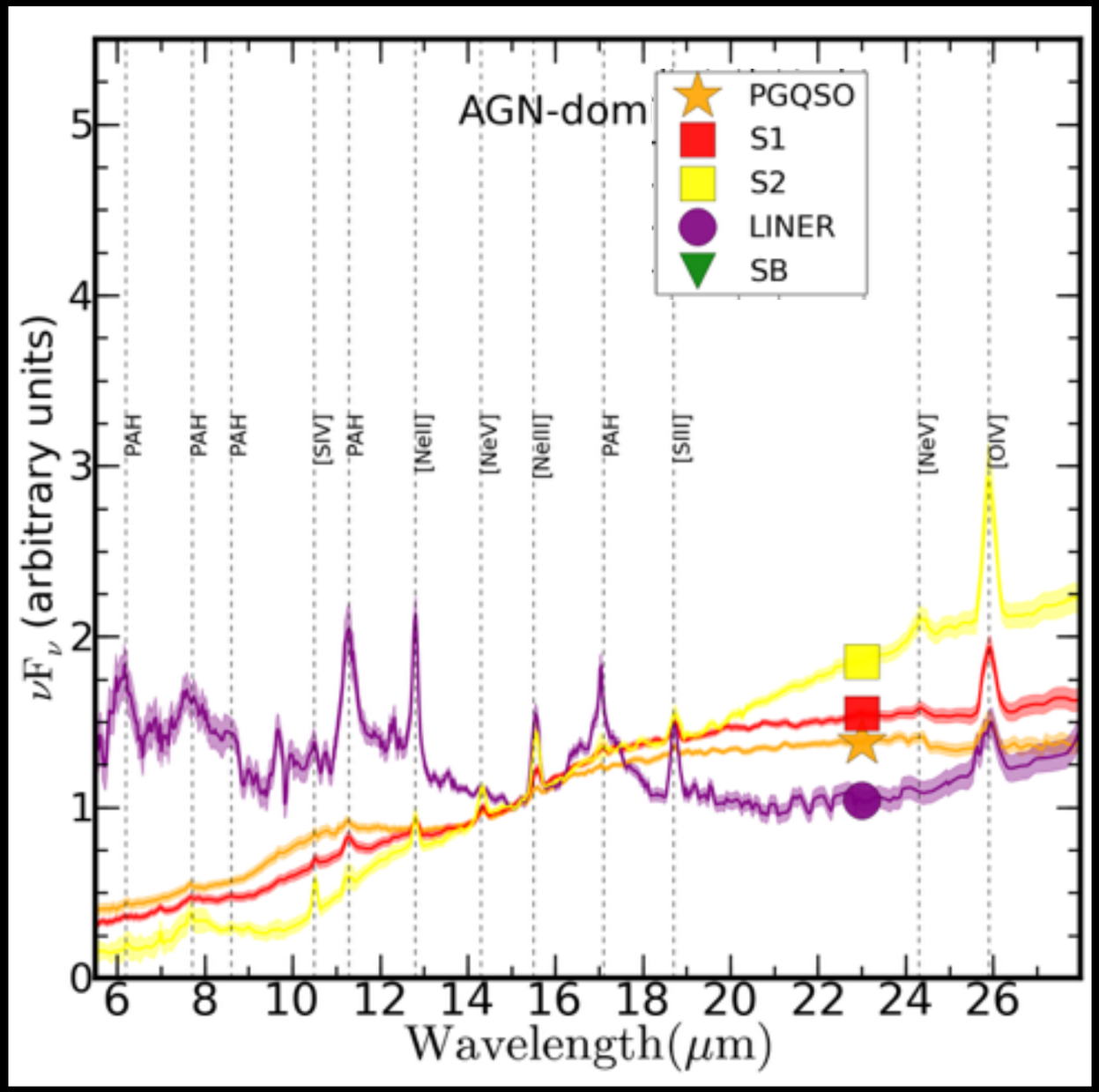
110 sources with *Spitzer*/IRS spectra:

- LINERs
- Seyferts
- Starbursts
- (PG QSOs)



Results I

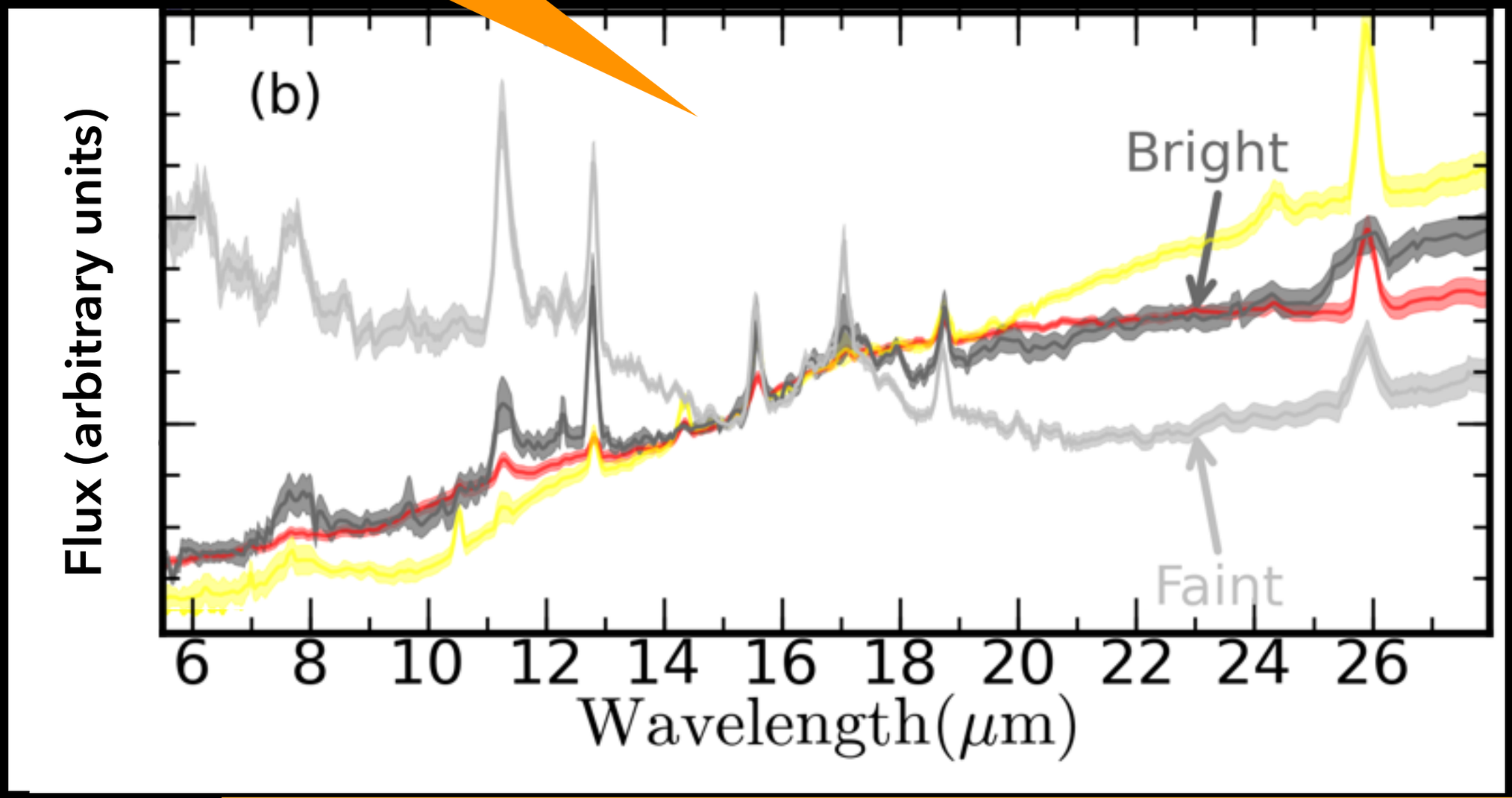
González-Martin et al.(2015)



Results I

González-Martin et al.(2015)

Faint LINERs:
$L_x<10^{41}$ erg/s



Results I

González-Martin et al.(2015)

Clumpy models fit to all but faint LINERs!

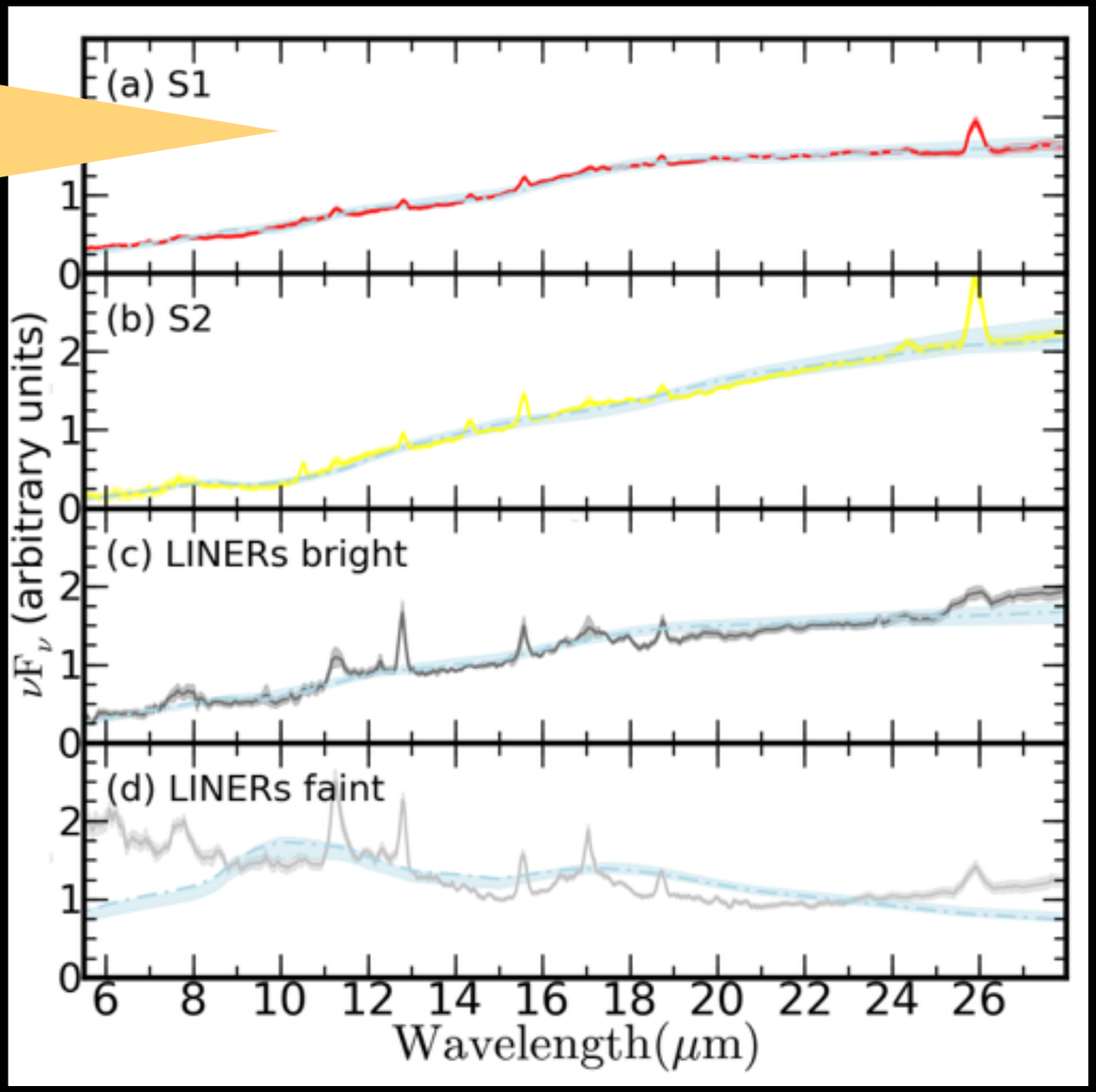
Is the torus disappeared in faint LINERs?

Credits to BayesClumpy:
Asensio-Ramos & Ramos-Almeida (2009)

Credits to Clumpy models:
Nenkova et al. (2008A,B)

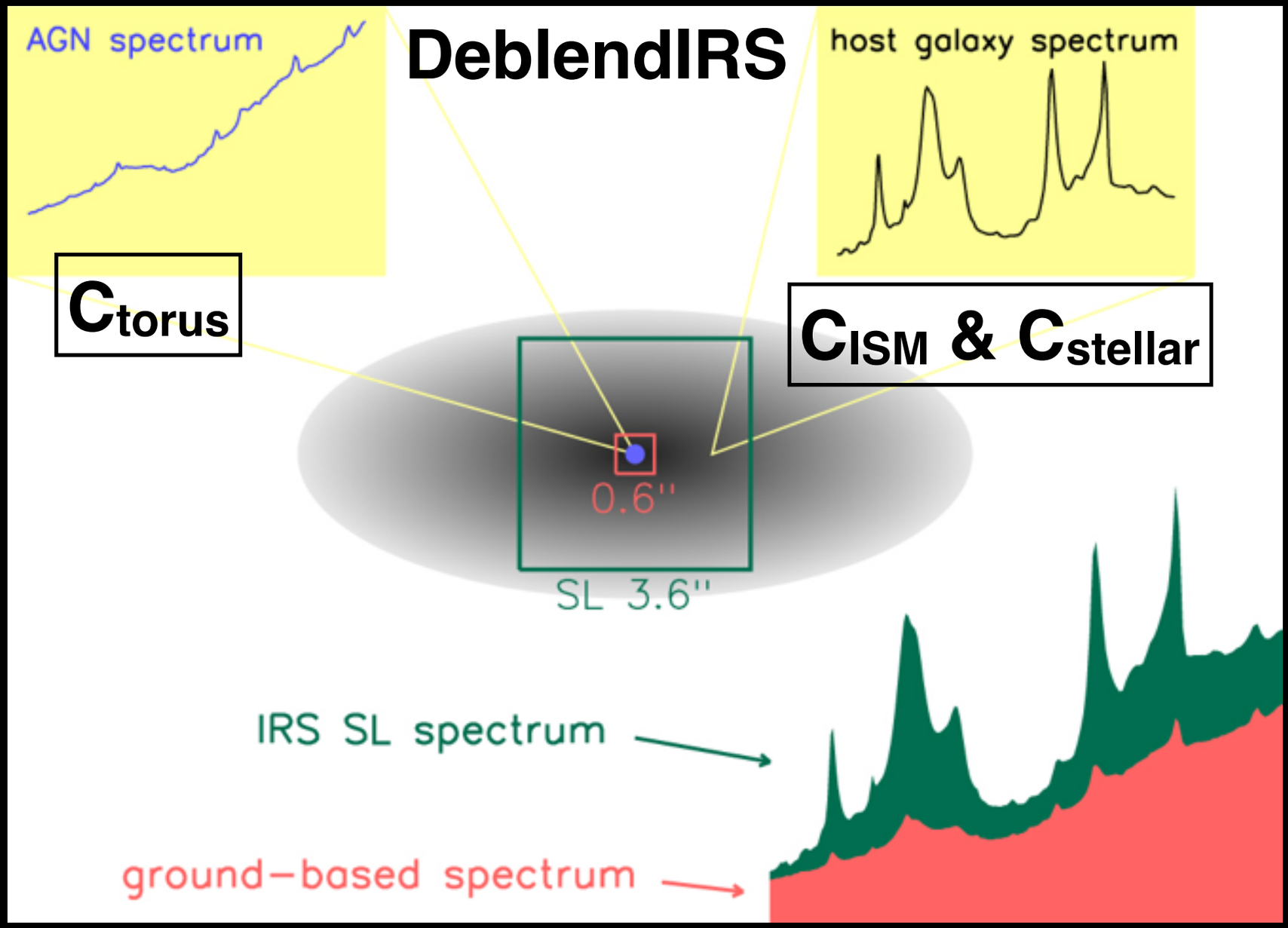
Elitzur & Ho (2009)

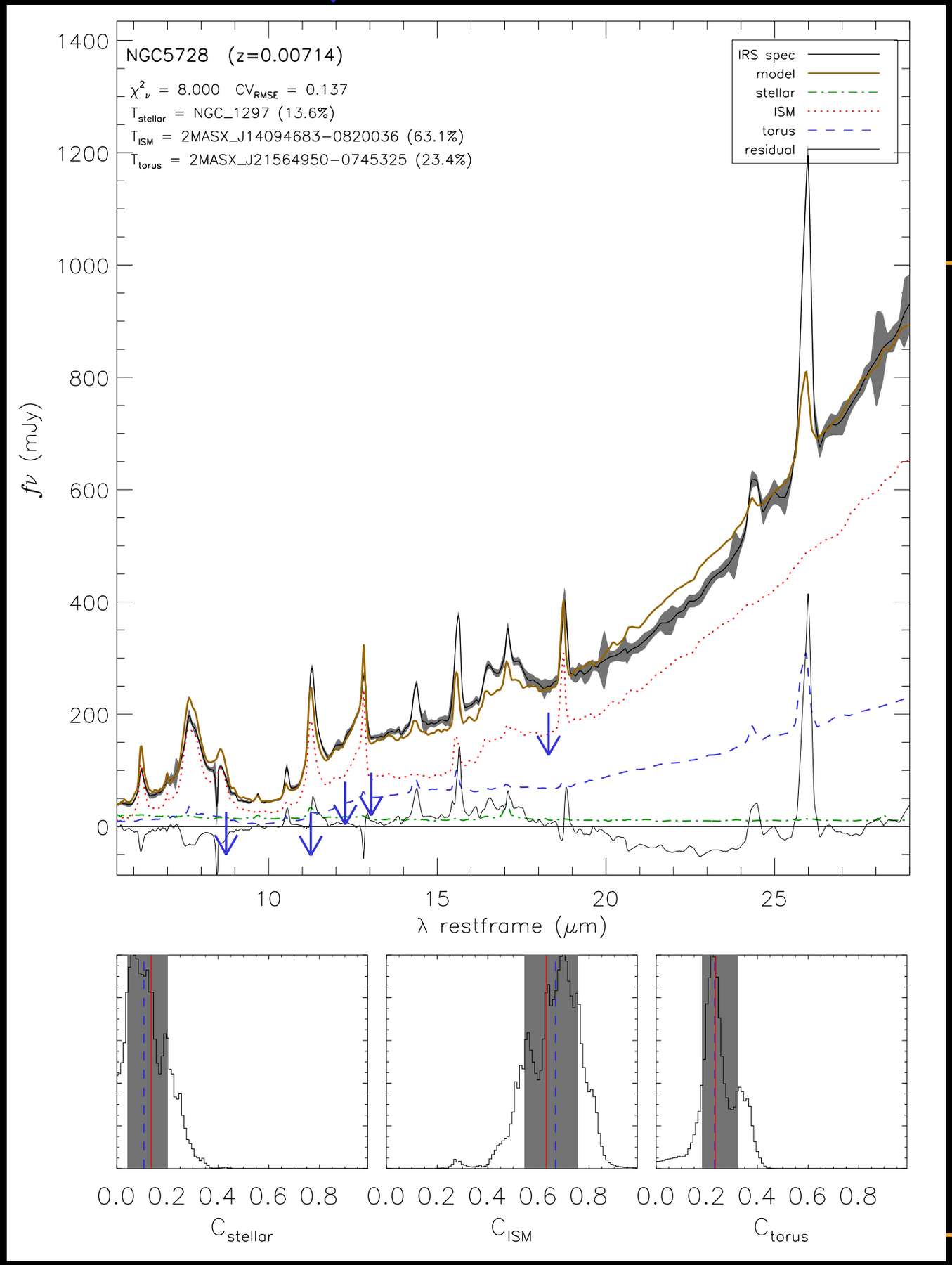
$L_{bol} = 5x10^{39} (M/10^{7}M_{o})^{(2/3)}$



Results II

Hernán-Caballero et al.(2015)

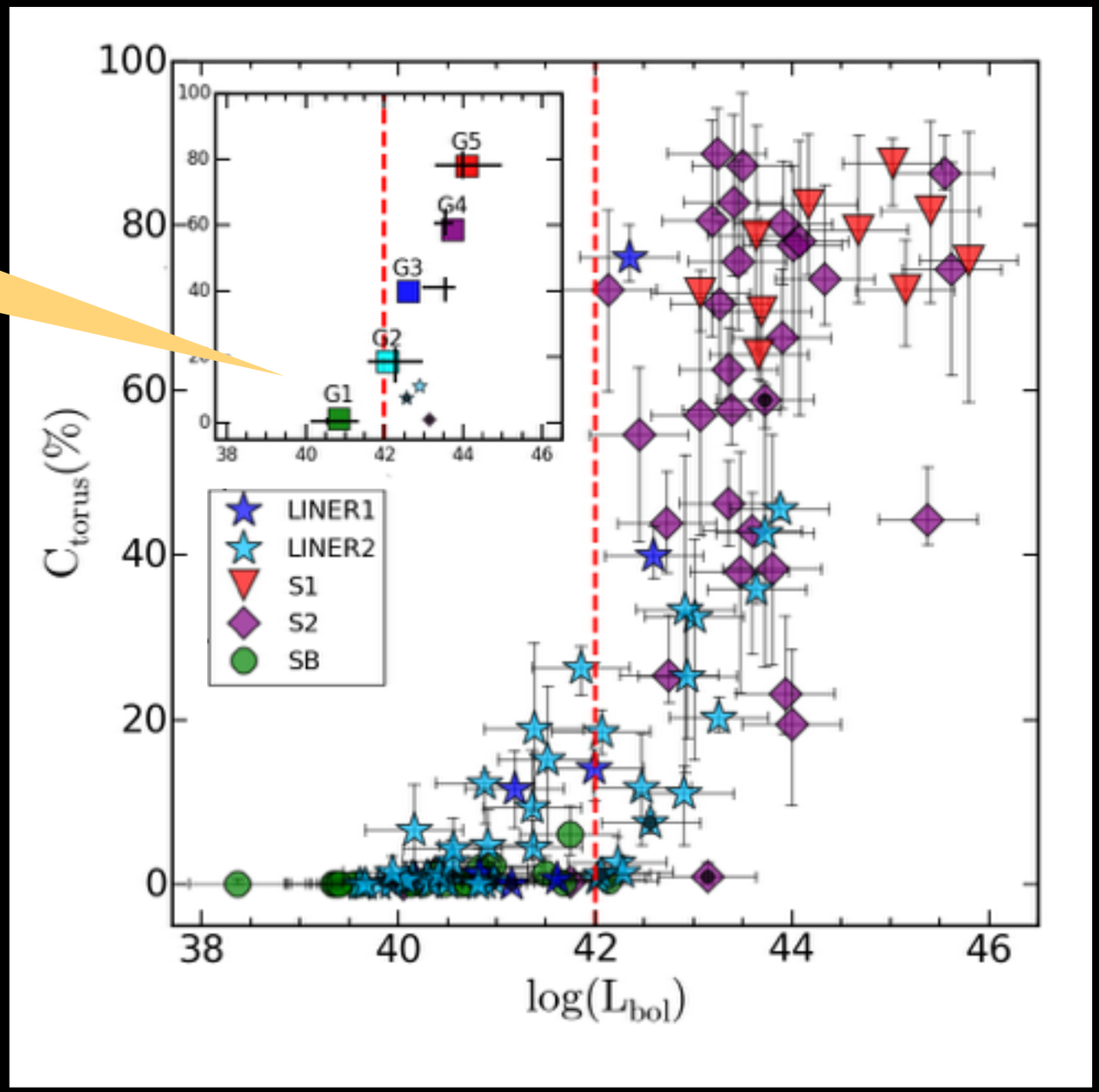



NGC5728 (z=0.00714)
χ^2_ν = 8.000 CV_{RMSE} = 0.137
$T_{stellar}$ = NGC_1297 (13.6%)
T_{ISM} = 2MASX_J14094683−0820036 (63.1%)
T_{torus} = 2MASX_J21564950−0745325 (23.4%)
IRS spec
model
stellar
ISM
torus
residual
$f\nu$ (mJy)
λ restframe (μm)
$C_{stellar}$
C_{ISM}
C_{torus}

Results II

Affinity Propagation clustering (Frey 2007)

Group	Representative member		Median of the group	
	$\log(L_{bol})$	C_{torus}	$\log(L_{bol})$	C_{torus}
1	40.8	1.3	40.5 (40.1,41.3)	0.6 (0,1.4)
2	42.1	18.5	42.5 (41.9,43.0)	18.8 (14.1,23.0)
3	42.6	39.8	43.5 (43.0,43.7)	41.2 (37.4,43.9)
4	43.7	58.8	43.5 (43.2, 43.7)	60.6 (57.4,64.8)
5	44.1	78.0	44.0 (43.3,45.0)	78.4 (74.9,82.3)



González-Martin et al.(submitted)

Results II

Observationally the torus seems disappears at L_{bol}~10^{41} erg/s

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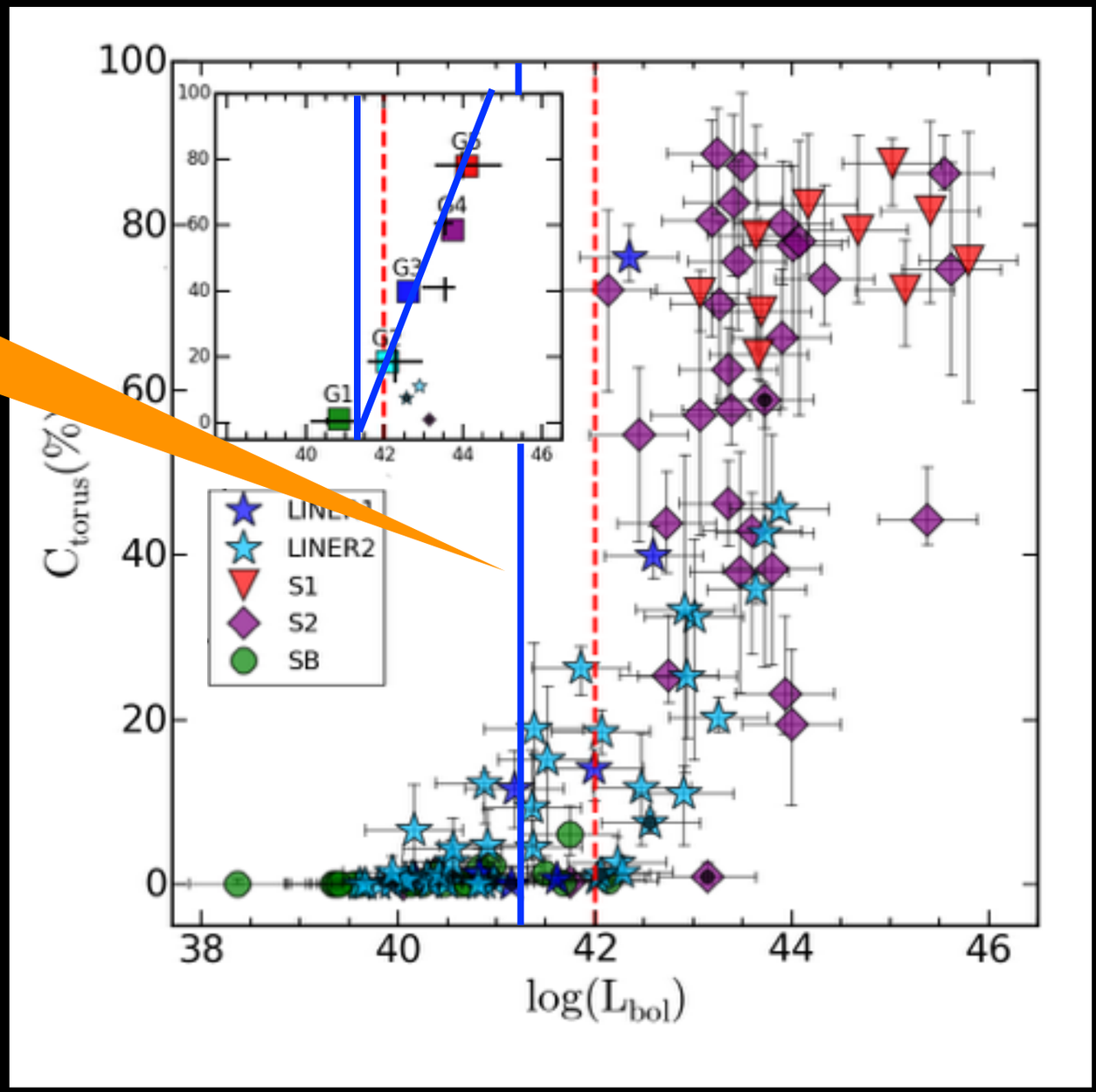

Elitzur & Ho (2009)

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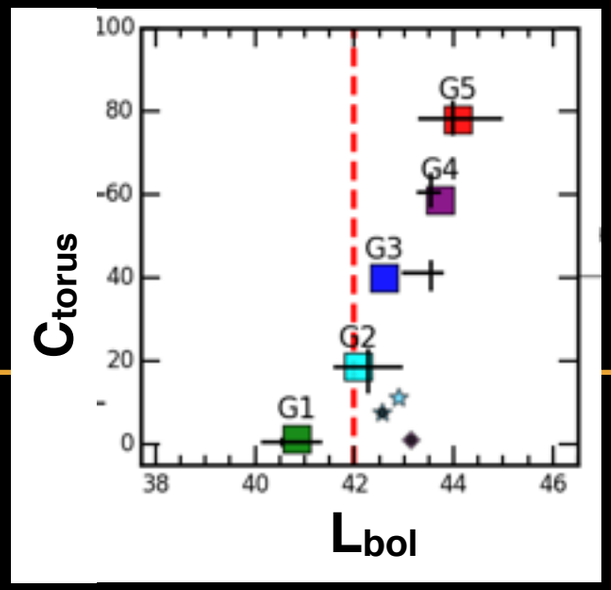
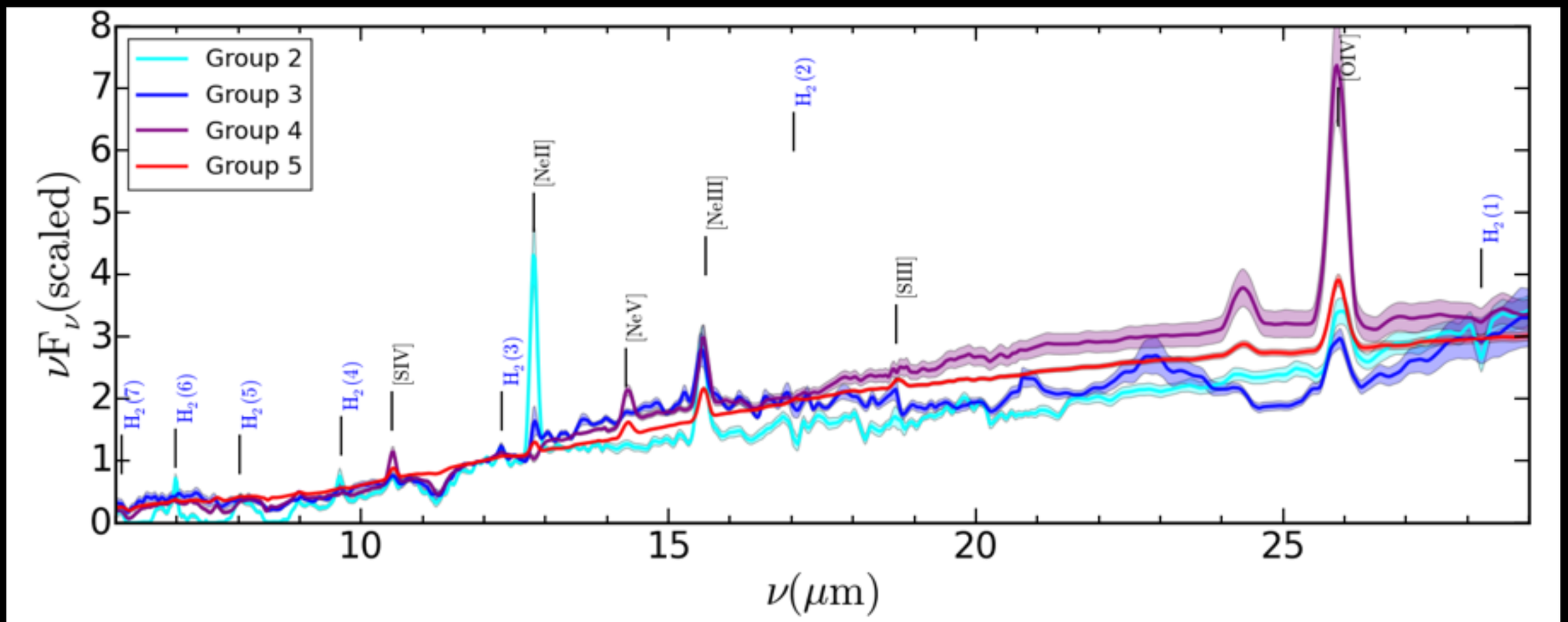
González-Martin et al.(submitted)

Results II

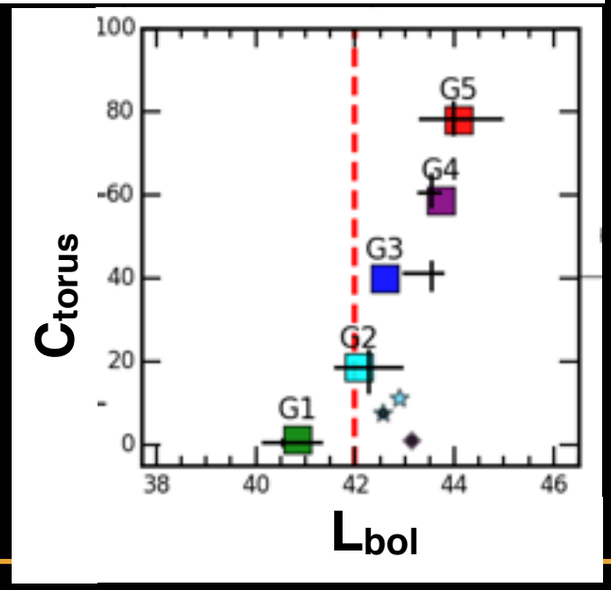




González-Martin et al.(submitted)

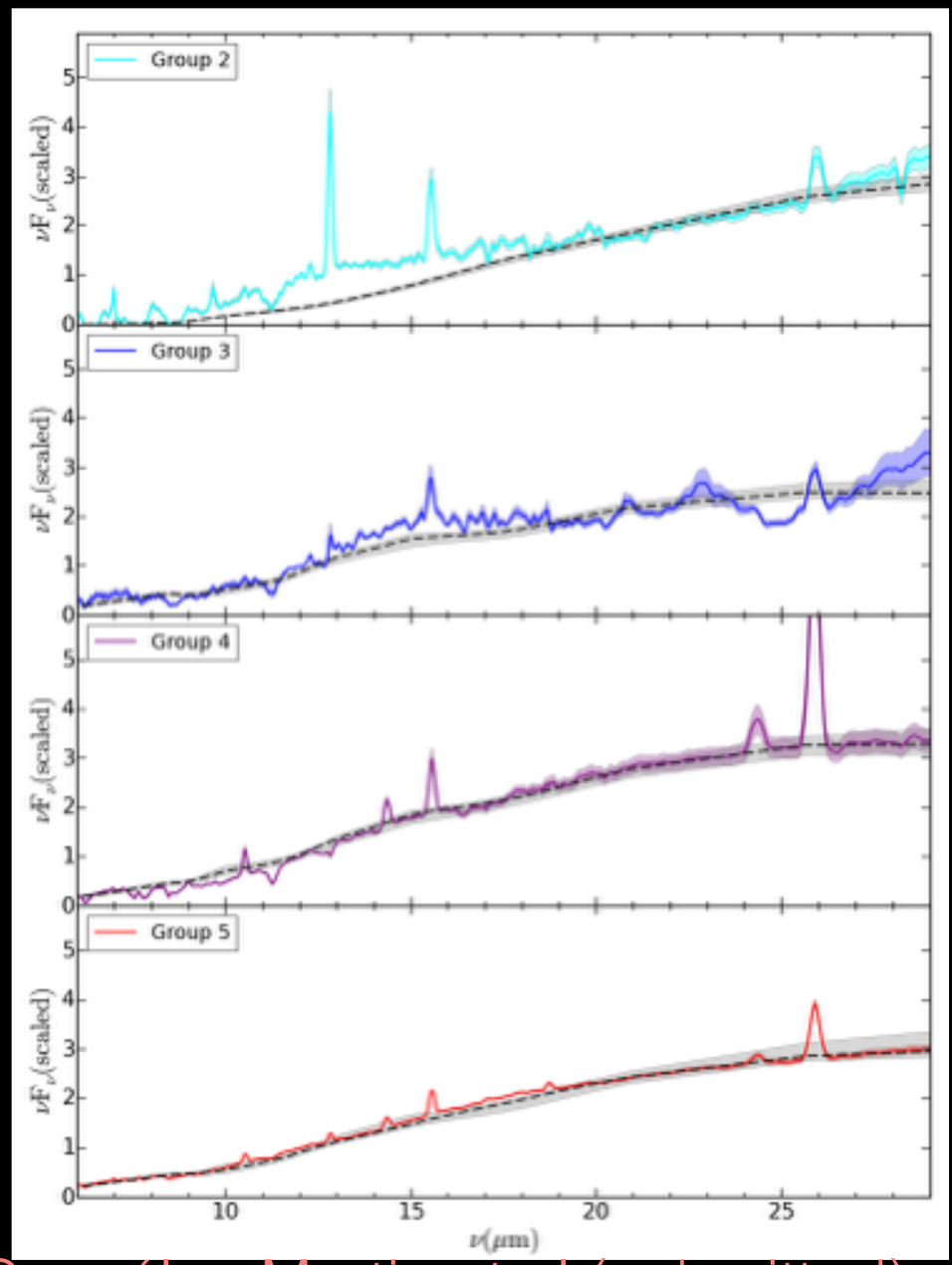
Results II

Param. (C_{torus})	Group 3 (40%)	Group 4 (60%)	Group 5 (80%)		
			All	Type 1	Type 2
σ	$52.0^{+9.2}_{-10.9}$	$47.9^{+12.4}_{-13.1}$	$37.8^{+18.5}_{-13.9}$	$36.1^{+14.5}_{-11.4}$	$34.5^{+16.6}_{-7.2}$
Y	$13.2^{+2.8}_{-2.0}$	$14.6^{+4.2}_{-2.0}$	$21.0^{+7.7}_{-3.1}$	$27.4^{+25.8}_{-8.1}$	$22.0^{+5.3}_{-2.8}$
R_{in}(pc)	0.025	0.089	0.14	0.14	0.14
R_{out}(pc)	$0.33^{+0.07}_{-0.05}$	$0.82^{+0.23}_{-0.11}$	$2.36^{+0.84}_{-0.34}$	$3.01^{+2.84}_{-0.89}$	$2.42^{+0.31}_{-0.58}$
N_o	$6.3^{+2.9}_{-1.5}$	$6.5^{+3.3}_{-1.7}$	$7.0^{+3.6}_{-2.2}$	$6.7^{+3.8}_{-2.8}$	$8.5^{+3.5}_{-2.5}$
q	$0.39^{+0.45}_{-0.25}$	$0.61^{+0.72}_{-0.40}$	$0.72^{+0.68}_{-0.46}$	$1.26^{+0.46}_{-0.56}$	$0.56^{+0.58}_{-0.36}$
τ_v	$70.9^{+24.8}_{-18.1}$	$110.0^{+21.1}_{-25.2}$	$63.5^{+27.2}_{-23.5}$	$42.2^{+32.3}_{-16.4}$	$43.0^{+20.9}_{-17.3}$
i	$58.2^{+17.7}_{-32.4}$	$59.5^{+15.6}_{-23.8}$	$64.9^{+12.6}_{-26.4}$	$35.3^{+22.1}_{-20.9}$	$73.2^{+9.2}_{-13.6}$
f_c	$0.74^{+0.13}_{-0.24}$	$0.67^{+0.16}_{-0.24}$	$0.48^{+0.26}_{-0.29}$	$0.42^{+0.22}_{-0.18}$	$0.45^{+0.27}_{-0.14}$

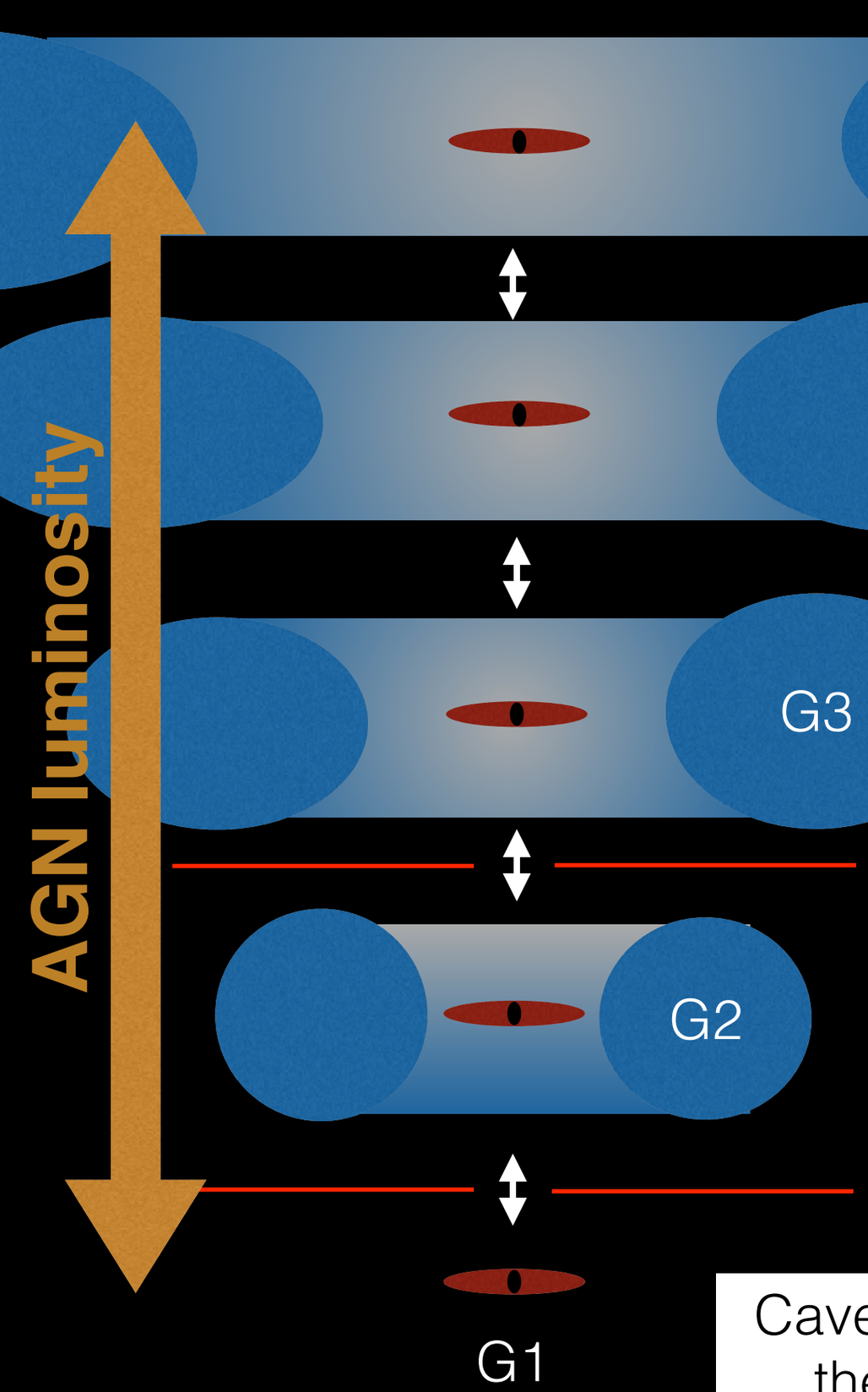


A limit for the Clumpy torus to stop working L_{bol}~10^{42} erg/s?

see also Muller-Sanchez et al. (2013)



González-Martín et al.(submitted)



THANKS!

Already submitted to A&A!

Clumpy torus?

L_{bol}~10^{42} erg/s

L_{bol}~10^{41} erg/s

Caveat: The host is still an uncertain contamination at these low-luminosities. MIRI/JWST!~50 times the sensitivity and 7 times the angular resolution of Spitzer

O. González-Martín, IRyA, Morelia, MX (Garching 2016)